PATENT SPECIFICATION 1,038,511

DRAWINGS ATTACHED.

1,038,511

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COMPLETE SPECIFICATION.

Tobacco Smoke Filter.

I, ADRIEN SCHNYDER, a Swiss citizen residing at 125, rue Centrale, Bienne, Switzerland, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a filter for purifying a stream of tobacco smoke from at least a part of the particles in suspension in said stream.

The filter has a general cylindrical shape and comprises a first portion which is permeable by the smoke, and a second portion which is impermeable. The relative proportions of the first and second portions are such that the smoke in passing through the first portion is accelerated, due to the reduction in effective cross-section of the filter, and its flow becomes turbulent.

The smoke drawn from the combustion zone of a cigarette is an aerosol of which the dispersion medium is air and combustion products such as carbon monoxide, carbon dioxide, water vapour, etc.

The other components of the aerosol come from the incomplete combustion of the tobacco and are formed of a great number of products such as tar, nicotine, resins, etc. These components are present in the state of a heterogeneous mixture of microscopic solid or liquid particles which do not obey the law of gravity but remain in suspension.

Known filter tips for cigarettes present a relatively great cross-section through which smoke flows at a moderate speed and in laminar conditions. Thus, practically each particle in the smoke remains separate from the others during its passage through the filter.

[*Price 4s. 6d.*]

On the other hand, if the flow of smoke is made strongly turbulent the particles come into contact with each other and agglomerate. In order to obtain a strongly-turbulent flow the speed of the smoke and the structure of the medium which has to be traversed are determining factors.

When a cigarette is smoked, the duration of one aspiration and the volume of the smoke produced by the aspiration are in an approximately constant ratio. For the same volume of smoke flowing in the same time, the speed of flow through a filter is necessarily the greater the less space is provided in the filter for the passage of the smoke. One obtains consequently a greater or less acceleration of the smoke during its crossing of the filter in reducing more or less the over-all effective cross-sectional area, in other words by obturating a part of the filter. Therefore, in accordance with the present invention, the filter is divided into at least two portions one of which is impervious to cigarette smoke and the other of which is readily permeable. To force the smoke to go exclusively through the voids of a permeable zone of reduced cross-sectional area does not diminish the porosity of a filter.

The relation between the flow of the smoke and the profile of the medium which it crosses requires a predetermined structure of the permeable zone. This comprises preferably a multitude of little more or less regular cavities, communicating through narrow apertures so that the paths thus formed in this permeable zone are tortuous and present a succession of constrictions and enlargements, which are particularly effective in causing the flow of smoke to become turbulent whereby the microparticles in the smoke come into contact with each other and agglomerate to

form macroparticles which are retained by the filter.

The filter according to the present invention offers the great advantage of being able to be made from materials which do not need to undergo, before or during the manufacture of the filter, any special mechanical, chemical, thermal or other treatment.

Another considerable advantage of the filter according to the invention is that it may be made by known processes and apparatus without any substantial modification.

The present invention will now be described in detail by way of example with reference to the accompanying drawings, in which:—

Fig. 1 is a transverse cross-section of a first embodiment of a filter incorporating the present invention and made out of a compound strip constituted by superimposed layers of material of different compactness;

Fig. 2 is a view in longitudinal cross-section of a section of one form of a compound strip used to form the filter of Fig. 1;

Fig. 3 is a view similar to Fig. 2 of a second form of compound strip;

Fig. 4 is a perspective view of a second embodiment of a filter of the present invention;

Fig. 5 is a view, part in cross-section, of the filter shown in Fig. 4;

Fig. 6 is a perspective view of a variant of the filter shown in Figs. 4 and 5;

Fig. 7 is a view, with part in cross-section, of the filter shown in Fig. 6;

Fig. 8 is a view in cross-section of a further embodiment of the invention made by moulding a multi-cellular plastics material;

Fig. 9 is a view in transverse cross-section of the filter shown in Fig. 8;

Fig. 10 is a view in longitudinal cross-section of another embodiment of the invention made of a loaded multi-cellular plastics material, and

Fig. 11 is a transverse cross-section view of the filter shown in Fig. 10.

The filter shown in Fig. 1 presents permeable portions 4 and impervious portions 3. This filter is made out of a compound strip such as one of those illustrated for example by the Figs. 2 and 3, and which comprises a layer of readily permeable material formed by one or more elemental sheets 1 sandwiched between layers 2 of a compact or impervious material, each formed by an elemental sheet. The readily permeable layer 1 is made in a material the texture of which comprises or allows the formation of numerous more or less regular cavities in communication with each other and thus giving rise to tortuous paths presenting a succession of constrictions and enlargements. This porous layer 1 is formed by a cellulosic fibrous material, such as a loose cellulose wadding, or by a cellular plastics sheet material, or any other sheet material having the mentioned characteristics. The outside layers 2 are of any natural or synthetic material, fibrous or not, such as unglazed tissue paper, or paper the faces of which are rough but not wrinkled. In practice any sheet material which is neutral with respect to the combustion and inhalation operations may be used provided that it be relatively rough, easy to fold, easy to cut off and impervious to smoke. The width of this compound strip is determined as a function of the thickness of the elementary sheet of which the strip is made and of the diameter a of the filter.

The manufacturing of the filter from this compound strip is by any suitable method. The strip is unrolled from a spool and fed to a machine where it is folded on itself, compressed and mechanically wrapped in a sleeve of paper 5 so as to be transformed into a continuous rod having the desired dimensions. This rod is further cut in sections of chosen length.

In the described construction, the permeable portion 4 and the compact portion 3 interpenetrate due to the folding so that a transverse cross-section of the filter (Fig. 1) shows a tangle of folds in the permeable and impervious layers, these tangled layers being continuous throughout the whole length of the filter.

In a cigarette provided with the described filter, the sucked smoke coming from the combustion zone and having passed through the section of unburnt tobacco is attracted towards the scattered permeable portions 4. Inside the porous portions 4 the flow of the smoke is conditioned by the section of the free space which the current has for its passage and through the general cellular structure of the filtering mass which it traverses. In the permeable portion 4 the smoke is thus divided in an infinity of partial currents which are each individually accelerated and brought to really turbulent conditions. The ambient temperature being near the dew-point, the condensed water vapour humidifies the walls of the filtering material. The cavities which define the passage of each partial current constitute expansion chambers on the inner walls of which the vesticulated macroparticles generated by the turbulence are incident and will be clogged. These innumerable expansions also cause a secondary cooling phenomenon. These processes cause the formation of abundant deposits, composed notably of tar and

nicotine, in the inside of the cavities of the permeable zone 4.

A filter such as described retains in normal conditions at least 50% of the tars and of the nicotine contained in the main smoke of a cigarette when the compound strip of which it is made is formed of two juxtaposed cellulosic wadding sheets sandwiched between two sheets of rough tissue paper, these two kinds of sheets weighing about 20 grams per m^2, the width of the endless strips being 130 mm and the filter tips having a diameter of 8.2 mm and a length of 12 mm.

The structure which has just been described by way of example is naturally modifiable between certain limits. The component parts of the filter do not have to be necessarily equilibrated; in a general way, the total section of the porous portion 4 must be between 40% and 60% of the total transverse cross-section of a cigarette filter. The length of the filtering tip is determined as a function of the desired retention and of the chosen composition. It is optional to use numerous other materials than the cellulosic wadding and the tissue paper. The width and the thickness of the compound strip may of course also be varied.

It is clear that manufacture of the described filter may also be by any suitable method. It starts from a multi-layer compound sandwich constituted by the superposition of the sheets of two different materials. The sandwich may be formed in one independent step or in the form of a continuous strip which is unrolled from a spool and engaged in the machine where it is cut into strips which are then joined, coated and cut to length. In this variant of manufacture it suffices to adjust the number of sheets of each of the two different materials of the composition of the material strip so that for a given width of the strip one obtains the necessary proportion and quantity of each of the two materials to form the desired filter. Due to the thickness of the sandwich, the consistency of the sheet of the impermeable material used and the roughness of their lateral faces have to be sufficient to ensure the cohesion of the strip during unrolling and cutting. The layers of different materials may be alternated in the sandwich but it is preferable in this case that the first and last sheets of the compound strip be always of the impermeable material to facilitate the mechanical processes.

In the embodiment illustrated in Figs. 4, 5, 6 and 7, the filter is constituted by elements which are uniformly and not randomly disposed. Continuous or discontinuous elements, preshaped or not, are particularly well suited for these embodiments. The elements can be composed of natural or artificial fibres agglomerated, formed in strips, adhered or not to cellulosic sheet material. The filter may be formed out of a strip of looped cloth which is adhered to a similar material which has been rendered impervious, or to another impervious material, so as to create an obturated, impervious tubular portion 11, and an axial cylindrical porous portion 12. The ratio of the cross-sections of the two portions is chosen to achieve the desired acceleration. The filter is wrapped in the usual impervious sheet material 13.

It is not necessary that the dividing line between the portions 11 and 12 be well defined: a certain interpenetration of these adjacent portions favours turbulence of the smoke.

In another variant illustrated in Figs. 6 and 7, the filter may comprise an impervious solid cylinder 16 surrounded by a sheet of permeable material 17 itself surrounded by a hollow cylinder 18 of impervious material. In all the cases, the quantity and the proportion of materials of different permeability are determined to achieve the desired results.

As shown in Figs. 8 and 9 a rod 33 of expanded synthetic resin is directly formed by moulding a plastisol. By this operation the moulded rod is provided with a tight and relatively rigid peripheral wall 34 which renders any subsequent wrapping unnecessary. In the transverse direction of the foam cylinder, the dimension and the permeability of the cells decrease radially from the centre towards the periphery so that the portion adjacent to the wall is formed of very little cells which are partially or totally closed, whereas the cells on the axis of the rod have expanded fully and are in communication with each other. A filter constituted by a section of rod of moulded cellular resin comprises a tubular impervious part 35 housing a foamed, approximately cylindrical, nucleus 36 which is readily permeable to smoke, the specific weight of which nucleus increases progressively towards the periphery.

Such a structure is well-suited to the present invention. For the moulding of relatively long or continuous elements out of a melted resin or pulverulent mixture, the expanded cellular composition may be sustained by means of a support, such as an axial cord which is preferably impervious.

As shown in Figs. 10 and 11, the filtering foamy complex is constituted by a composition of communicating, relatively-uniform cells 37, and of closed elements 38. Such a material can be prepared by adding to certain plastisols a material which produces a multi-cellular composi-

tion containing a proporation of closed, i.e. impervious, cells regularly distributed throughout the matrix. The multi-cellular resins may also be loaded in any other suitable manner. The impermeable material used to load the foam has to comply to the requirements for innocuity, colour, size, etc., and be light enough in order not to increase too much the specific weight of the resultant product. The function of the incorporated load in the cellular composition is to limit the space available for the passage of the smoke in order to create turbulent flow conditions: if it happens that this operation, due to the properties of the loading material used, reinforces the filtering material to give it a particular absorption, adsorbtion, oxidation or other power with regard to the undesirable substances, this subsidiary result is welcome but not is primary purpose.

The filter may be made of homogeneous mixtures of permeable cellular preformed elements and non-cellular impervious elements.

The cohesion of the filter formed out of this mixtures may be reinforced by means of a binding agent. The fabrication of such a filter in a continuous rod involves the same techniques as the manufacture of the cigarette itself.

Among the materials capable of constituting the impervious component, are fragments of cellulosic materials, wood chips or sawdust, cork granules, lint, kapok, and other very short natural or artificial fibrous elements etc.

WHAT I CLAIM IS:—

1. A tobacco smoke filter having two portions of which one is permeable to the smoke and defines a plurality of communicating constrictions and enlargements along the length of the filter, and of which the other is substantially impermeable to the smoke, the total effective cross-sectional area of the impermeable portion being at least 40% of the whole cross-sectional area of the filter at all points along the length of the filter.

2. The filter claimed in claim 1, in which the filter is substantially cylindrical, and in which the shape and size of the enlargements are substantially the same throughout the permeable portion.

3. The filter claimed in claim 1 or 2, in which the permeable and impermeable portions are constituted by different elements.

4. The filter claimed in claim 3, in which the two elements extend longitudinally of the filter and are closely juxtaposed.

5. The filter claimed in claim 3, in which the filter is substantially cylindrical, and in which the two elements are distributed substantially uniformly throughout the body of the filter.

6. The filter claimed in claim 1, in which the size and shape of the enlargements in the permeable portion are a function of their position in the filter.

7. The filter claimed in claim 3, or claim 3 and any claim dependent thereon. in which the permeable element is formed by at least one sheet of cellulosic wadding weighing about 20 grams to the square metre, and in which the impermeable element is formed by at least two sheets of rough tissue paper weighing about 20 grams to the square metre, the cellulosic wadding being laid between two sheets of tissue paper to form a sandwich which is repeatedly folded on itself, perpendicularly to its axis, to form a cylindrical filter.

8. The filter claimed in claim 4, in which the permeable element is in the form of a cylinder of circular cross-section, and in which the impermeable element is in the form of a hollow cylinder of annular cross-section intimately surrounding the permeable element.

9. The filter claimed in claim 4, in which the permeable element is in the form of a hollow cylinder of annular cross section surrounding a solid cylinder of circular cross-section of impermeable material and surrounded, in turn, by a hollow cylinder also of impermeable material.

10. The filter claimed in claim 6, in which both the portions are formed from the same synthetic cellular material.

11. The filter claimed in claim 8 or 10, in which the permeable portion is constituted by completely-expanded synthetic resin forming open and communicating cells, in which the impermeable portion is constituted by the same synthetic resin but only partially expanded forming partially or wholly-closed cells not in communication with each other.

12. The filter claimed in claims 10 and 11, comprising a central axially-extending support member.

13. The filter claimed in claim 11, in which the cylinder is moulded or extruded from the synthetic cellular material.

14. The filter claimed in claims 12 and 13, in which the support member is of fibrous material.

15. The filter claimed in claim 5, in which the permeable portion is formed from an expanded synthetic resin, and in which the impermeable portion is formed by impervious particles distributed throughout the expanded resin.

16. The filter claimed in any of claims 1, 4, 5 and 6, in which the filter is constituted by a mixture of impervious and pervious particles, said pervious cellular particles being in communication with each other through constrictions.

17. A tobacco smoke filter, substanti-

ally as described herein, with reference to and as shown in Figs. 1, 4 and 5; Figs. 6 and 7; Figs. 8 and 9, or Figs. 10 and 11 of the accompanying drawings.

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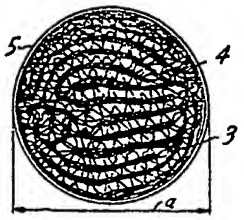

Fig. 1

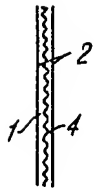

Fig. 2

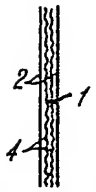

Fig. 3

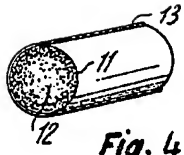

Fig. 4

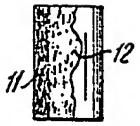

Fig. 5

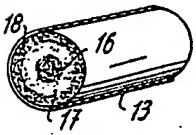

Fig. 6

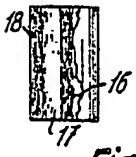

Fig. 7

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Sheets 1 & 2

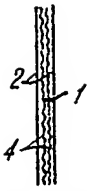

Fig. 3

Fig. 8

Fig. 9

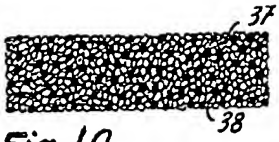

Fig. 10

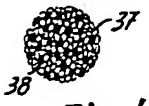

Fig. 11

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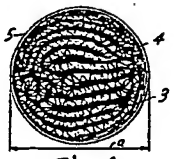

Fig. 1

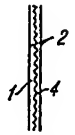

Fig. 2

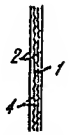

Fig. 3

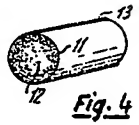

Fig. 4

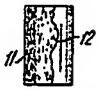

Fig. 5

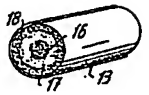

Fig. 6

Fig. 7

Fig. 8

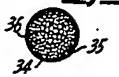

Fig. 9

Fig. 10

Fig. 11